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ABSTRACT

To comprehend the roles of education and the workplace in the year 2000, one must project as clearly as possible the total societal environment and then draw from it the unique characteristics of these two social elements. Until recently, that process could be accomplished utilizing relatively straight line extrapolation of current conditions. However, we find ourselves at the beginning of the third major non-violent revolution in the history of mankind, which like the agricultural and industrial revolutions that preceded it, will result in the radical change of nearly all aspects of human life. Among the effects of the information and telecommunications revolution will be: (1) most citizens will be required to have a substantially greater education as automation and computerization take over nearly all routine work; (2) computer resources, including microelectronics, artificial intelligence, and robots, will be as pervasive as electric energy is today; and (3) advances in biotechnology and genetic engineering will have significant commercial implications. The results of this revolution are not likely to include drastic reductions in the workforce, but rather will require more accurate projections of a changing job market and the provision for appropriate and comfortable role changes for workers. At Oregon Institute of Technology, efforts are being made to create a completely computerized campus by 1987 to give graduates the skills and knowledge demanded by new technologies and an awareness of the necessity of lifelong learning. (AYC)

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EDUCATION AND TRAINING:
INSTITUTIONS AND THE WORKPLACE TO THE YEAR 2000

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PLENARY SESSION
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EDUCATION AND TRAINING:
INSTITUTIONS AND THE WORKPLACE TO THE YEAR 2000

In order to comprehend the roles of educational institutions and the workplace in the year 2000, one must project as clearly as possible the total societal environment of that day and then draw from it the unique characteristics of these two elements.

Until ten or twenty years ago, that process was fairly easily accomplished utilizing relatively straight line extrapolation of current conditions. However, we now find ourselves in a rapidly changing technological society where such convenient mechanisms are no longer relevant. For that clearer picture, I suggest that we take the lead of such futurists as Daniel Bell in his "Post Industrial Society" and Alvin Toffler with the "Third Wave" and recognize that we are, indeed, in the beginnings of the third major non-violent revolution in the history of humankind.

By recognizing the characteristics of such non-violent revolutions and the fact that they result in the radical change of nearly all aspects of human life, we may be able to get a clearer picture of our immediate future.

To recap, the first of these revolutions has been entitled the Agricultural Revolution. It began some ten thousand years ago and can be symbolized by the seed and the plow. Because humankind, by settling in one place and growing crops, was, for the first time in history, able to obtain a relatively reliable long term supply of food and not depend upon the vagaries of nomadic existence with its periodic hunger and starvation. By doing so, humans found most aspects of life significantly changed. For the first time, they began to build towns

and cities, sturdier habitation, roads, streets, sewers, different social structures, political structures, different ways of viewing leisure, and different educational processes.

This revolution, now nearly complete on the face of the earth, has taken nearly ten thousand years to complete, although within a certain group of people, it probably took only centuries.

The second such revolution, the Industrial Revolution, began 300 years ago and can be symbolized by the steam engine. It marked the time when humankind had, at its disposal, significantly more power than that of individual humans and their domesticated animals. Although some use had been made of wind and water power and mechanical leverage, this revolution utilized not only wind and water power, but steam, fossil fuel, nuclear, and solar power. Again, all aspects of human, social, economic, physical, educational, and leisure life were changed.

The current such revolution, called by some the Information and Telecommunications Revolution is symbolized by the integrated circuit. It represents a time when humans are able to go beyond the confines of their own brains in terms of information storage, sorting, compiling, relating, and presenting. This revolution, compared to ten thousand years and 300 years for the past two, I predict, will be substantially complete in less than 30 years. And, like the first two, will change significantly nearly all aspects of human life.

To take a look at one aspect of human life as it changed through these revolutions, one might look at the basic social unit. In the nomadic period, the basic social unit was the clan, traveling together, surviving together, not necessarily related or in compact sub-units. When the clan got too large to function properly, it split into two or more new clans. When it became too small to function properly, it either joined another clan or went out of existence. In the agricultural society, the basic social unit was the extended family with parents and children, grandparents, and other assorted relatives living in the same unit, managing the family farm or the family cottage industry. When the industrial society came into existence, the extended

family was no longer useful and, therefore, we saw the rise of the nuclear family with father going to work, mother staying at home to raise and educate the children, and the children preparing themselves for similar work roles in their adult life. It is now projected by most social futurists that the nuclear family will no longer be the basic social unit into the future, but rather, because of the flexibility of the society, many different social units will arise with no one in the majority. In fact, the "ideal" family described above is no longer in the majority in North America.

What can we say about the influences upon education in general terms? First, it is well to recognize that the coin of the realm in agricultural society is land, in industrial society is capital, and in the new society is, and will be, knowledge. In the agricultural society, there was little or no need for any formal education and only a very select few in the leisure class had that luxury. Even today, in such countries as Egypt, the "fellah" resist compulsory education, desiring to keep his children in the fields as a part of his own personal workforce. In the industrial society, a greater percentage of people were afforded more education, but the majority were afforded only such educational training as necessary to become the workers in the factories, shops, and institutions of that society. Now and in the future, a majority of all citizens will be required to have a substantially greater education as automation and computerization takes over nearly all routine, dull, monotonous, and often dangerous, work.

Of all the major groupings of technological changes, there are three which are expected to have the most impact during this current, and future, non-violent revolutions.

The first, is that of the continued rapid implementation and pervasiveness of computer resources, including microelectronics, computers, software, artificial intelligence, intelligent robots, information processing, communications, and other related areas. It is my estimate that, in ten years, computing resources will be as

pervasive in our society as electric energy is today, probably as necessary, and, hopefully, as easy to operate as user-friendly devices continue to hit the marketplace. I estimate that by the year 1990, 80% of all employed individuals in developed societies will spend all or part of their day at a computer console. Nearly all of us will come into contact with computers in such wide-ranging areas as automated tellers, automobiles, electric appliances, household security and fire alarm systems, and, most certainly, in our educational institutions.

Following close on the heels of the Information and Telecommunications Revolution is another one which might be described as a part of that one or as a unique one following only ten years behind. That is the revolution in biotechnology or genetic engineering. This revolution, aided considerably by microelectronics, will see significant commercial developments within the decade in plant and animal genetics, pharmaceutical manufacturing, and the genetic side of medicine, health care, and disease cure and prevention. For example, researchers in Davis, California, have, through three genetic splices, created a brand new strain of peaches which grow to five feet rather than twelve feet, are fully developed in four years rather than seven, can be planted 1,000 to the acre rather than 100, and produce thirty tons per acre rather than fifteen. In Canada, Dr. David Suzuki has, for several decades, been acquainting Canadians with such revolutionary changes in biotechnology.

Finally, another unique trend, as a spin-off of biotechnology, which will significantly affect future life is that of a drastic elongation of lifespan. As I talk to high school and college-age youth today, to familiarize them with drastic future change, I suggest that their average lifespan will be 120 years with the older ones living to 150 and beyond. This will probably increase the normal retirement age to at least 100 years.

Other areas of significant change in the immediate future are in material science, where we will create and produce many exotic alloys, ceramics, and plastics; in energy fields, where we will create new forms of energy, transform existing ones, and modify, greatly,

our storage and transmission capacities; and in the commercialization of space, where large new contingents of humans will actively work either in space or in earthly support of space activities.

Regarding the future workforce, currently I hear an old myth from the past about drastic reductions in the workforce which I described in a recent article as, "The Manpower Surplus Myth Revisited." In the early 1960's, as I left engineering to join education, the prevalent thought, which I also voiced, was that computerization and automation would create a society in which, by the year 2000, 10% of the adult population could perform the meaningful work for all of society, raising a serious issue as to what would happen to the rest of us. Here we are, well over halfway to the year 2000 and that dreaded aspect of change has not been realized at all, in fact, new job creation has outstripped the population growth of even the baby boom. In fact, only the reduction of the percentage of workers engaged in agriculture, dropping from 15% to 2½% in thirty years, as well as the increasing percentage of women in the workforce, from 35% to 52% over the same period, have we been able to staff all of those jobs.

Certainly, as automation and computerization continue to create certain job obsolescence, we can still expect new job creation to continue at a rapid pace. As an example, a senior Vice President of American Telephone and Telegraph, at the most recent World Assembly of the World Future Society in 1982, indicated that within the previous decade the telephone system of North America had been so automated and computerized that in the very near future, one will seldom hear a human voice on the system except, hopefully, the one he or she desired to reach in the first place. And, yet, during that decade, the workforce of the Bell System did not decrease, did not stabilize, but increased by 50% from 800,000 to 1,200,000. This is but one example of the uselessness of that myth. As the population of the trough following the baby boom joins the workforce between now and the year 2000, I would speculate that job creation will, again, continue to outstrip population growth and that we will only be able to meet those demands

through increasing the retirement age or opening the gates to immigration.

Still, within this scenario, lies a serious dilemma for the workplace and the educational and training institutions which serve it. Job obsolescence, along with new job creation, has always been with us, but, in the past, it has always taken decades rather than years as in the present. The wagon train driver gradually became a truck driver, with no loss in earnings or prestige. However, the modern auto worker, with good job satisfaction and salary level must change rapidly into an uncertain future in computer manufacturing or other job markets, requiring significantly increased skills and knowledge while, most likely, suffering significant loss of earnings. The more we are able to accurately project the changing job market and provide appropriate, comfortable, and satisfying role changes for workers from a manipulative job market to a knowledge job market, the better we will serve our society and the individuals within it.

At Oregon Institute of Technology, we recognize that our graduates will be workingin this increasingly technological society and are moving rapidly to give them skills and knowledge to meet the demands of that society as well as to create in them an awareness that life-long learning is no longer a luxury, but a necessity. Oregon Tech is a four-year, baccalaureate-granting, polytechnic college granting 25 different degrees in the high technology areas of engineering, health, and business. It emphasizes practical "hands-on" training with an inverted curriculum, granting both two-year Associate in Applied Science and four-year Bachelor of Science degrees, and being rewarded with a 97% graduate placement record, the highest in the United States.

As we anticipate the future, a first significant step will be the completion of the "Completely Computerized Campus" by 1987. Even at the present time, nearly all of our students are computer literate, from taking a minimum of an introductory course to state of the art training in Computer Systems Engineering Technology. Approximately 15% of our students own their own personal computers as well as over 30% of our faculty, while the college supplies a computer terminal

room, with 50 terminals and a dozen microcomputers open 24 hours a day, seven days a week.

The 1987 OIT system will be anchored by a main computing system largely used for common data bases, program storage, and large number crunching requirements and will be tied together with a digitized local area network of voice, data, video, graphics, and conferencing capacity. Each faculty member and administrator will have a work station of up to two gigabites of memory for word processing, information inquiry, student advising and registration, grade reporting, mail, memoing, message and directory service, information search and retrieval, computer conferencing, etc. The library will be fully computerized for inventory, acquisition, interlibrary loan, check in/out, and on-line search. Each student will purchase his or her own inexpensive, yet powerful, interactive microcomputer. Such a computer, with word processing, graphics, spread sheet, and 256 k, will be available in 1987 for under $300. Finally, certain instructional processes, such as CAD/CAM will require in-laboratory computing resources, but not banks and banks of terminals or micro-computers.

By constantly anticipating society's education and training requirements, Oregon Institute of Technology intends to continue to serve that society to the year 2000 and well beyond.

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